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This report presents documentation for a Soviet force effectiveness model. It contains an overview of the project and the complete computer program annotated passim to enable a better understanding of its logic and structure.

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FINAL TECHNICAL REPORT

DEVELOPMENTAL METHODOLOGIES FOR MEDIUM- TO LONG-RANGE ESTIMATES: PROGRAM DOCUMENTATION FOR SOVIET FORCE EFFECTIVENESS MODEL (U)

September 1976

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PREFACE

This document is one of a series of reports describing the research activities undertaken to complete Defense Advanced Research Projects Agency (ARPA) supported contract number MDA903-76-C-0255, entitled "Developmental Methodologies for Medium- to Long-Range Estimates." These reports describe the project's empirical, methodological, substantive, technical, and theoretical contributions.

The Final Technical Report is presented as a set of documents rather than a single report. They are

- Executive Summary,
- Long-Range Regional Forecasting Models,
- The Soviet Force Effectiveness Model,
- User's Manual for the Long-Range Regional Forecasting Models,
- User's Manual for the Soviet Force Effectiveness Model, and
- Program Documentation for the Soviet Force Effectiveness Model.

The first three volumes substantively describe all research tasks, provide the rationale for research decisions, and report important findings. The remaining four volumes document the two computer programs delivered to the Defense Intelligence Agency/Directorate for Estimates (DIA/DE) for installation on the Defense Intelligence Agency On-Line System (DIAOLS).

The Executive Summary briefly describes the overall project. The volumes on the regional forecasting model and the force effectiveness model, by far the most substantive and complex of the documents, discuss the design and development of each of these models, respectively. The first reviews the regional models, identifies areas where improvements were made for DIA/DE, and presents the findings from sensitivity tests and computer simulations for Europe, the Middle East, Latin America, and Africa. The second fully discusses the development of the Soviet force effectiveness model. The volume is classified.

The remaining four volumes focus on the two computer models delivered to DIA/DE. A user's manual and program documentation have been written that provide all necessary information for using and maintaining the models.

ACKNOWLEDGEMENTS

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PROJECT OVERVIEW

This User's Manual describes one of two important analytical technologies developed for the Defense Intelligence Agency/Directorate for Estimates (DIA/DE) under Defense Advanced Research Projects Agency (ARPA) Contract No. MDA903-76-C-0255, designed to improve the capability to forecast important factors that define the international military environment and have implications for long-range intelligence estimates. Two user-interactive computer models were developed in this project. The first enhances existing Department of Defense forecasting capabilities (CACI, 1975b, 1974, 1973) by applying social science research methodologies to long-range forecasting of important economic, military, and political variables. The second major product is a model that enables DIA/DE to measure total Soviet force effectiveness for use in estimative intelligence. Together, these efforts constitute technological innovations that enhance the reliability, accuracy, relevance, timeliness, and, therefore, the credibility of long-range forecasting for defense intelligence estimates and planning. This manual describes the user-initiated procedures for the regional long-range forecasting models.

This project had four objectives:

1. Refine and equalize the existing long-range forecasting models for Europe, the Middle East, Latin America, and sub-Saharan Africa, previously developed under ARPA contracts for the Joint Chiefs of Staff (JCS/J-5).

2. Enrich the existing models by including the People's Republic of China as a major actor in the superpower simulation capability and adding the option to simulate the impact of political regime changes.

3. Develop a model to estimate future Soviet force effectiveness based on the Defense Intelligence Projections for Planning (DIPP) document, including the capacity of the Soviet Union to improve the quality and quantity of its major weapon systems and pose increased threats to U.S. interests.

4. Implement the enriched forecasting models and the Soviet force effectiveness model on the Defense Intelligence Agency On-Line System (DIAOLS) with a user-interactive capability to permit DIA analysts to forecast alternative futures by altering data, superpower behavior, or regime type, and/or forecasting parameters to simulate different courses of action.

ACCOMPLISHMENTS

All phases of the research were completed so that offices with established DIAOLS linkages can access either the CACI regional forecasting models or the Soviet force effectiveness model. As proposed,

- The regional forecasting models have been standardized at comparable complexity for Europe, the Middle East, Latin America, and sub-Saharan Africa, and China has been added to the superpower influence set;

- The capability to influence forecasts by simulating regime changes was added and the models were made user-interactive;

- Sensitivity tests and simulations have been performed with each of the models, and the three programs associated with the regional forecasting models (the preprocessor, forecasting program, and report generator) have been installed on DIAOLS;

- The Soviet force effectiveness model has been developed using information available in the DIPP on the number and characteristics of Soviet weapon systems;

- An equation was developed that selectively aggregates weapon characteristics, interfaces them with DIPP force level information, and generates estimates of Soviet force effectiveness;

- A program for the Soviet force effectiveness model that permits user-interaction with the weapons system data and alternative assumptions about the growth and structure of Soviet forces has been implemented on DIAOLS and is presently available.

The two computer models considerably enhance DIA/DE's forecasting capability, as intelligence estimators can now generate and analyze long-range alternative futures for Europe, the Middle East, Latin America, and Africa, or alternative estimates of Soviet force effectiveness. In each case, the analyst has available a computer technology that permits structures and assumptions of either model to be altered to reflect an insight about the phenomenon being studied. Furthermore, the intelligence estimator has guidelines on how to interface the long-range regional forecasts with estimates of total Soviet force effectiveness. As analysts become more familiar with both models, their sensitivities to the implications of the generated forecasts and estimates will increase. More questions will eventually be asked that will tax the limits of the models. Finally, as they gain currency throughout the intelligence community, demands for increased sophistication and refinement can be expected.

The models produced by this research integrate traditional academic approaches and complex quantitative methodologies to develop tools that can improve intelligence estimates. In addition, the research interfaced qualitative and quantitative techniques that are intermingled in any modeling effort. It also produced vastly improved, standardized, and user-interactive versions of CACI's regional forecasting models.

Moreover, it produced the first generation of a user-interactive Soviet force effectiveness model that relies on highly sophisticated intelligence data. The lessons learned in completing these two major efforts should be intensely scrutinized by potential users.

CACI's past efforts in developing the regional forecasting models have involved collecting and organizing statistical information, applying statistical analytical techniques, examining the implications of data error, designing and constructing forecasting models, designing and developing user-interactive programs, applying regional versus country-specific forecasting equations, and so on. Each effort has clearly improved the reliability and validity of the regional forecasting models, thus advancing considerably the credibility of forecasts.

Even with these advances, continuing technology assessments suggest a number of unmet, yet very necessary, steps which must be taken to ensure that the best possible regional models are developed for the national security community. Some of these are

- Develop worldwide medium- to long-range estimative intelligence technologies. Currently, no model exists for Asia. Limited effort would be required to expand the current system to include that region. Further, the current structure contains the United States, the Soviet Union, and the People's Republic of China as influential superpowers. This set could, and should, be expanded to include Japan and the major Western European countries.

- Develop stochastic mechanisms for superpower interaction simulation. While including additional superpower influences is a substantial step toward improving the realism of a worldwide model, only the independent

effects of the superpowers will have been modeled. The action-reaction nature of superpower behaviors and the impacts of such activity on other nations can now only be indirectly simulated. These aspects can and should be modeled in greater detail.

- Explore and apply methodologies to enrich regional forecasts. Constraining the analyst's perspective to define sets of countries geographically has, to some extent, made modeling more difficult. One solution is to estimate country-specific parameters, an approach that has worked extremely well with the economic sector of the current model. However, when data are insufficient or inadequate, the relationships among environmental variables should be modeled for similar types of countries. These procedures should produce increasingly accurate forecasts.

The lessons learned from modeling Soviet force effectiveness should also be intensely evaluated. As expected, the data in the DIPP are more readily available for larger weapons. Consequently, a force effectiveness model favoring the available data was developed. Thus, the effectiveness of general purpose forces (naval, tactical air, and ground) is less well assessed by the current model. During the project, CACI continually clarified DIA/DE's specific interests on Soviet force effectiveness. For example, the distribution of off-line and on-line systems became important, as did the distinction between nuclear and non-nuclear weapons. Furthermore, distinctions as to the role of specific weapons (either offensive or defensive) sometimes became important in considering weapon effectiveness.

The current Soviet force effectiveness model discriminates between nuclear and non-nuclear weapons and off-line and on-line systems. It is also capable of aggregating different weapon systems to simulate specific missions. Other advances can readily be made.

- Identify forces by geographical region, permitting combinations of offensive and defensive capabilities in specific locations such as Europe, South Asia, and China.

- Evaluate Soviet force effectiveness of weapons in both an offensive and defensive role. This would considerably enhance the intelligence estimator's knowledge of the dimensions of force effectiveness and the overall effectiveness of specific forces analyzed in the DIPP.

- Develop measures of U.S. force effectiveness for offensive and defensive systems, located in selected geographical areas, to compare with Soviet force effectiveness measures. Such an analysis could eventually develop new technologies for quantitative net assessment.

Technology assessment is an ongoing process in which model builders and model users review and try to improve the range and quality of existing products. CACI's long-range forecasting models have been subjected to precisely this kind of scrutiny. This discussion identified new areas where further improvements should be made. The same is true of the Soviet force effectiveness model. As more users become acquainted with it, technology assessment will begin. The resulting feedback will contribute to the growth that must continue if forecasting and estimation capabilities within the Department of Defense are to become part of the policy-planning process in the national security community.

SOVIET FORCE EFFECTIVENESS PROGRAM SUMMARY

Program Type:	Interactive
Program Objective:	Computation of the effectiveness of user-selected Soviet weapon systems for the years 1972-1981
Program Features:	A user is permitted to • Select weapons by DIPP table or by assigned mission, • Examine questionable data values, • Change any data values (except in the permanent weapon data files), and • Add new weapons.
Program Input:	• DIA DIPPOLS file • CACI weapon attribute file • User-supplied information from the terminal during program execution
Program Output:	Tables showing the effectiveness of selected Soviet weapons for the years 1972-1981.
Program Language:	FORTRAN
Computer System:	DIAOLS
Developer:	CACI, Inc.-Federal
Program Operations:	Shown in Figure 1

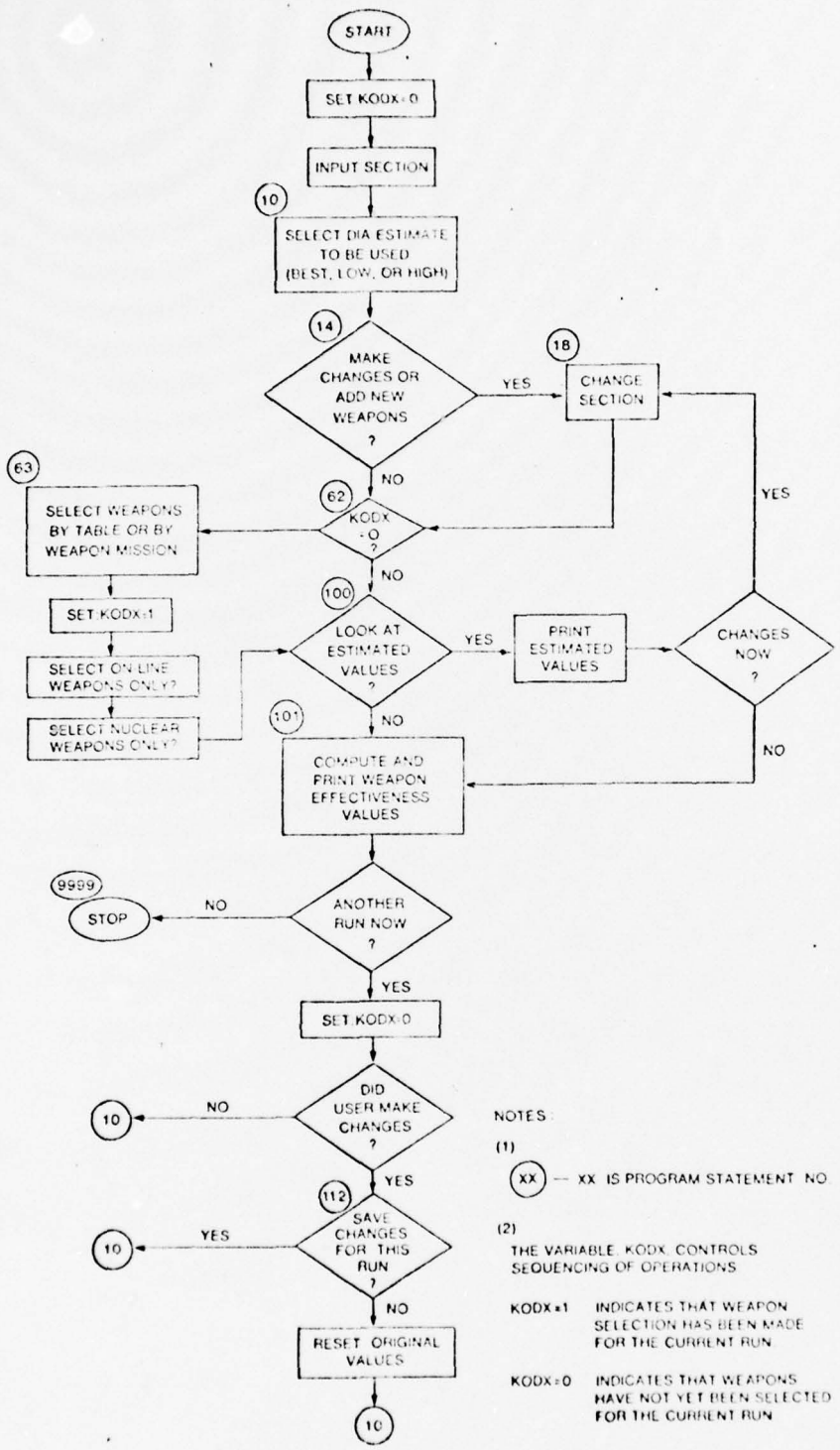

Figure 1. Operational Flow Diagram of the Soviet Force Effectiveness Program

PROGRAMMER'S NOTES

1. The variables are defined in Table 1.

2. The 36 tables whose ID's are stored in array TLIST (see lines 2061-3065 in subroutine IPUT) are read from the DIA file. The three DIA estimates are stored in the single array, IW. Table names to be entered by the user are stored in array NTAB1 (see lines 160-170 in the main program).

3. The DIA DIPP tables are read at each program execution. No program changes are required when changes in the DIA estimates of the numbers of weapons currently in the files are made.

4. If new weapons are added to the DIA files, the following changes are needed:

   - The names and attributes of the new weapons must be added to the attribute file, 'CONDATA1.'
   - The numbers of weapons in the tables must be updated (array 'NTAB2').
   - The initial value of 'NWP' must be reset.
   - If more than five new weapons are added the dimensions of arrays WPNID, IW, XW, and XWAST must be increased.

5. The starting year for the computations is 1972. It is controlled by the variable, 'STARTYR', which is set to 72 in a data statement (line 140). Changing this value will change the starting year.

6. An annotated program listing is attached.

TABLE 1

Definitions of Variables

Variable	Definition
WPNID(I)	Ith weapon identification code
IW(K, I)	Integer characteristics of the Ith weapon K = 1-5, mission codes K = 6, on-line code K = 7, nuclear code K = 8, not currently used K = 9-18, DIA's best estimates of the numbers of Soviet weapon I for the years 1972-1981 K = 19-28, DIA's low estimates K = 29-38, DIA's high estimates
XW(K, I)	Attributes of the Ith weapon K = 1, Number of warheads K = 2, Yield K = 3, Payload K = 4, CEP K = 5, Reliability K = 6, Velocity K = 7, Vulnerability
XWAST(K, I)	Set to '*' if the corresponding attribute is estimated
NTAB1(K)	Name of the Kth of 12 DIA tables into which the weapons are organized
NTAB2(K)	Numbers of weapons in the Kth table
LTAB(K)	Starting index of the Kth table

Continued

Table 1
Variables Definitions
Continued

Variable	Definition
SMAX, VMAX	MAXIMA of velocity, vulnerability
NATT(K)	Name of the Kth weapon attribute
KODS(I)	Selection code for the Ith weapon 1, weapon selected for printing; 0, weapon not selected
IWO(L), JWO(L), XWO(L), IAO(L)	Storage arrays for initial weapon attribute values and their indices
KODN(I)	Code: 1, the user has changed the numbers of the Ith weapon 0, no changes in the numbers of this weapon have been made
IC(J)	User-entered weapon numbers for the Jth year
CACIFILE, DATFILE, INDFILE	Names of input files
DUMMY, IFLAG, ISRT, IPMAX, INDMAX, RPTFILE, FACFILE, NPREFIX	Common variables needed by the 'SUBATT' and 'SEEK' subroutines
NWP	Number of weapons read from DIPP files
MAXN	Maximum array size for weapon data (allows space for five new weapons to be added by the user)
NAT	Number of weapon attributes
NTB	Number of DIA tables
NMS	Not currently used
STARTYR	Starting year (last 2 digits)

DECLARATION STATEMENTS

```
10 COMMON DUMMY(36),IFLAG,ISRT,IPMAX,INDMAX,DATFILE,RPTFILE,FACFILE,
20 &INDFILE,UPREFIX
30 COMMON/ONE/WPNID(257),IW(38,257),XW(7,257),XWAST(7,257),NTAB2(12),
40 &LTAB(12),SMAX,VMAX
50 CHARACTER *11 KW,WPNID,ITOT,HELPX
60 CHARACTER *2 KKW,BE,EN,HE,HI,LO,NO,TA,MI
61 CHARACTER *2 KC,INS,IES,IAS
62 CHARACTER *4 NTAB1,END,HELP,NAM,ITB
64 CHARACTER *4 NATT
70 CHARACTER *1 XWAST,UPREFIX,LIST,LANK,H,IASO
71 CHARACTER *1 IAO,MIS
72 CHARACTER *2 KKK
80 INTEGER STARTYR
90 CHARACTER *14 CACFILE,DATFILE,INDFILE,RPTFILE,FACFILE
100 DIMENSION NTAB1(12),NATT(7),LIST(6),KODS(257),IC(10),WEF(10),
110 &IWO(38),JWO(38),XWO(38),IAO(38),TOT(10)
120 DIMENSION KODN(225),IYEAR(10)
140 DATA NAT,NTB,NMS,STARTYR/7,12,14,72/
150 DATA NWP,MAXW/225,257/
160 DATA NTAB1/4H1A  ,4H1B  ,4H1C  ,4H2   ,4H3B01,4H3C  ,4H4A  ,4H4B01,
170 &4H4B06 ,4H4B10 ,4H4B19 ,4H4C   /
180  DATA NTAB2/42,7,37,10,12,6,6,22,31,18,22,12/
190 DATA LIST/1H1,1H2,1H3,1H4,1H5,1H6/
200 DATA NATT/4HWHD  ,4HYLD ,4HLOD ,4HCEP ,4HREL ,4HSPD ,4HVUL /
210 DATA L6/1000000/
220 DATA LANK,ITOT/1H ,11H      TOTALS  /
```

```
230 DATA BE,EN,END,HE,HELP,HI,LO,NO,TA/2HBE,2HEN,4HEND ,2HHE,4HHELP
240 &,2HHI,2HLO,2HNO,2HTA/
250 DATA MI,H,IASG/2HMI,1HH,1H*/
260 EQUIVALENCE (KW,KKW)
```

Names of the three data files are set. The CACI file, CONDATA1, contains weapon attribute data. UDATRAND and UINDEX are DIA files.

```
262 CACIFILE="DIPP/CONDATA1;"
264 DATFILE="DIPP/UDATRAND;"
266 INDFILE="DIPP/UINDEX;"
```


The array, IYEAR, contains the numerical values of the years for which computations are made. It is used only in printing headings for the output.

```
267 IXY=STARTYR+1899
268 DO 269 I=1,10
269 269 IYEAR(I)=IXY+I
```

Initial values of the local variables, MC, LS, and KODX, are set. MC is the number of changes made by the user in this run. KODX = 0 indicates that the weapons have not yet been selected.

```
270 MC=0
276 KODX=0
```

Array KODN is set to 0. KODN(I) = 0 indicates that the numbers of the Ith weapon have not been changed.

```
277 DO 278 I=1,NWP
278 278 KODN(I)=0
```

Weapon data will be placed into arrays WPNID, IN, and XN. The index of the first weapon in each table is computed and stored in LTAB.

```
280       LTAB(1)=1
290       DO 9 K=1,11
300     9 LTAB(K+1)=LTAB(K)+NTAB2(K)
```


The subroutine, IPUT, is called to read all input files.

```
320 CALL IPUT(MAXW,NAT,NTB,CACIFILE,NWP,STARTYR)
```

Various format statements are used primarily to read the user's responses.

```
330     1 FORMAT(1X,17A4)
340     2 FORMAT(A2)
350     3 FORMAT(A4)
360     4 FORMAT(A1)
370     5 FORMAT(A11)
```

The user is requested to specify the DIA estimates to be used in the computations. The beginning and ending indices, LS and LE, are set to select the weapon numbers from array, IN.

```
372 PRINT,"YOU MUST SPECIFY WHICH DIA ESTIMATES YOU WILL USE"
374 10 PRINT,"ENTER 'BE' (BEST), 'LO' (LOW), OR 'HI' (HIGH),"
375 READ 2,IES
376 IF (IES,NE,HE) GO TO 12
377 PRINT,"SEE USER'S MANUAL FOR DEFINITIONS OF BEST,LOW, AND HIGH"
378 PRINT,"ESTIMATES"
379 GO TO 10
380 12 IF (IES,EQ,BE) LS=9
381 IF (IES,EQ,LO) LS=19
382 IF (IES,EQ,HI) LS=29
383 IF (LS,EQ,0) GO TO 10
384 LE=LS+9
```


The user now indicates whether or not weapon attributes or numbers are to be changed.

```
386 PRINT,"DO YOU WANT TO ADD NEW WEAPONS OR MAKE CHANGES IN THE"
390 PRINT,"WEAPON NUMBERS OR ATTRIBUTES "
400 14 READ 2,KC
410C IF NO CHANGES TO BE MADE, SKIP CHANGE SECTION
420 IF (KC,EQ,NO) GO TO 62
430C IF USER NEEDS HELP, PRINT INFO; ELSE BEGIN CHANGE SECTION
440 IF (KC,NE,HE) GO TO 18
450 PRINT,"ENTER NO TO USE DIA ESTIMATES AND STORED WEAPON DATA"
455 PRINT,"ENTER YES TO CHANGE WEAPON DATA OR TO ADD UP TO 5 NEW WEAPONS"
460       GO TO 12
```

This is the program section in which changes are made.

The user enters an 11-character weapon identification code.

```
500 18 PRINT,"ENTER WEAPON ID"
510       READ 5,KW
```

KW= "NO" ends change entries; KW= "HE" produces more information for the user.

```
530       IF (KKW ,EQ, NO) GO TO 52
540C BRANCH AROUND HELP LOOP IF NOT NEEDED
542 DECODE(KW,500) KKK
544 500 FORMAT(A2,9X)
550 IF (KKK,NE,HE) GO TO 20
560 PRINT," SEE MANUAL FOR COMPLETE LIST , EXAMPLES ARE :"
570       PRINT 6,(WPNID(J),J=1,5)
580     6 FORMAT(5(1X,A11))
590       GO TO 18
```

The index, I, of this weapon is found.

```
610    20 DO 22 I=1,NWP
620       IF (KW ,EQ, WPNID(I)) GO TO 24
630    22 CONTINUE
640 PRINT,"WEAPON NOT FOUND IN LIST"
650    :   GO TO 18
```

The user may enter new values for the numbers of weapons in the 10 years for which computations are to be made.

```
660 24 PRINT,"DO YOU WANT TO CHANGE NOS. OF WEAPONS "
670       READ 2,INS
680C IF NO,BRANCH AROUND NUMBER CHANGE ROUTINE
690       IF (INS .EQ. NO) GO TO 34
700C BRANCH AROUND HELP LOOP IF UNNEEDED
710       IF (INS .NE. HE) GO TO 30
740 26 PRINT," ENTER NEW VALUES FOR THE 10 SELECTED YEARS "
750       GO TO 24
760C PRINT CURRENT VALUES FOR WEAPON KW
770 30 PRINT 7,IYEAR(1),IYEAR(10),WPNID(I),(IW(J,I),J=LS,LE)
780 7 FORMAT(" NOS. FOR THE YEARS ",I4,"-",I4," ARE :"/1X,A11,10I5)
790 PRINT,"ENTER NEW NUMBERS FOR 10 YEARS"
800       READ,IC
```


Array IC contains the new values entered by the user. They are stored in the same (computer) words as the initial values. For example, the word will now contain

NNNNNNOOOOOO

where NNNNNN is the new value for number of weapons and OOOOOO is the old value.

```
830 DO 32 J=LS,LE
840 JA=J-LS+1
850 32 IW(J,I)=IC(JA)*L6+IW(J,I)
855 KODN(I)=1
```

The user may also change the attributes of this weapon.

```
860 34 PRINT,"DO YOU WANT TO CHANGE WEAPON ATTRIBUTES "
870       READ 2,INS
880C IF NO, BRANCH TO START OF CHANGE ROUTINE TO BEGIN ANOTHER WEAPON
890       IF (INS .EQ. NO) GO TO 18
900C BRANCH AROUND HELP LOOP IF UNNEEDED
910       IF (INS .NE. HE) GO TO 42
920 PRINT,"ATTRIBUTES ARE : WHO(NO.),YLD(YIELD),LOD(PAYLOAD,ROUNDS),"
921 PRINT,"CEP(CEP),REL(RELIABILITY),SPD(VELOCITY), AND VUL(VULNERABILITY"
940       GO TO 34
```

The user enters the attribute name, and its index is located.


```
950 42 PRINT,"ENTER ATTRIBUTE NAME "
960       READ 3,NAM
980       IF (NAM .EQ. END .OR. NAM .EQ. NO) GO TO 18
990       IF (NAM .NE. HELP) GO TO 46
1000 44 PRINT,"ALLOWED ENTRIES ARE :"
1010       PRINT 8,(NATT(J),J=1,7)
1020     8 FORMAT(7(1X,A4))
1030       GO TO 42
1040C GET ROW INDEX OF XW FOR NAM
1050    46 DO 48 J=1,7
1060       IF (NAM .EQ. NATT(J)) GO TO 50
1070    48 CONTINUE
1080 PRINT,"ATTRIBUTE NOT FOUND IN LIST"
1090       GO TO 44
```

The current value of the attribute is printed and the user enters the new value.

```
1110    50 PRINT 19,XW(J,I)
1120    19 FORMAT(17H STORED VALUE IS ,F12.4)
1130 PRINT,"ENTER NEW VALUE"
1140       READ, VAL
```

The change counter, MC, is incremented, and the old value and its indices are stored for later use if the user wishes to reset initial values for another run.

```
1160       MC=MC+1
1170 XWO(MC)=XW(J,I)
1180 IAO(MC)=XAAST(J,I)
1190       IWO(MC)=I
1200       JWO(MC)=J
1210       XW(J,I)=VAL
1220 XWAST(J,I)=LANK
```

If the maximum number of 38 changes has been reached, program control is transferred to the next section; otherwise, the user may enter another change.

```
1230 IF (MC,EQ,38) GO TO 52
1250       GO TO 42
```

The user may add new weapons.

```
1270    52 MA=NWP
1280 53 PRINT,"DO YOU WANT TO ADD A WEAPON "
1290       READ 2,IAS
1310       IF (IAS .EQ. NO) GO TO 62
```

The user is prompted by the program as to the weapon data to be entered.

```
1320 PRINT," ENTER NAME AND NOS. OF WEAPONS FOR YEARS 1972-1981,"
1340       MA=MA+1
1350 READ,WPNID(MA),(IW(JA,MA),JA=LS,LE)
```


The selection code, mission codes, and on-line, nuclear codes are set so that this added weapon will be included in the computations regardless of other weapons selected by the user.

```
1370       KODS(MA)=1
1371 DO 51 JA=1,7
1372 51 IW(JA,MA)=1
```

Values for the attributes of the new weapon are added.

```
      DO 54 K=1,7
      PRINT 900, NATT(K)
  900 FORMAT(19H ENTER A VALUE FOR ,A3)
      READ, XW(K,MA)
XWAST(K,MA)=LANK
   54 CONTINUE
```

The maximum weapon speed and vulnerability, SMAX and VMAX, are identified as the attribute file is read. They may be reset if the values for the new weapon are larger.

```
1442 IF (XW(6,MA).GT.SMAX) SMAX=XW(6,MA)
1444 IF (XW(7,MA).GT.VMAX) VMAX=XW(7,MA)
1470 IF (MA-257) 53,55,55
1480 55 PRINT,"NO MORE WEAPONS MAY BE ADDED. "
1490 GO TO 62
```

This is the weapon selection section. The selection codes in array KODS are set to 0. The user is asked to indicate whether selection will be by table or weapon mission.

```
1590 62 IF (KODX) 63,63,100
1600 63 DO 64 L=1,NWP
1610   64 KODS(L)=0
1620 KODX=1
1630 66 PRINT,"ENTER 'TA' (TABLE) OR 'MI' (MISSION) "
1640   68 READ 2,INS
```

Any answer to this question except "MI" will be treated as a selection by table.

```
1650        IF(INS .EQ. MI) GO TO 86
```

Table selection section. The user enters the Table ID and its index, L, is found.

```
1660C TABLE MODE SECTION
1670  72 PRINT,"ENTER TABLE ID,"
1680        READ 3,ITB
1690C BRANCH AROUND HELP LOOP IF UNNEEDED
1700        IF(ITB .NE. HELP) GO TO 78
1710  76 PRINT," ALLOWED ENTRIES ARE :"
1720        PRINT 901, NTAB1
1730   901 FORMAT(12(1X,A4))
1731 PRINT," 1A=ICBM, 1B=MRBM, 1C=SLBM, 2=LRA, 3B01=APVO, 3C=SAM,"
1732 PRINT," 4A=SSM, 4B01=SSN, 4B06=L3C, 4B10=SSC, 4B19=SNA, 4C=FA"
1740        GO TO 72
1750C GET INDEX OF TABLE ID SPECIFIED
1760    78 DO 80 L=1,NTB
1770        IF(ITB .EQ. NTAB1(L)) GO TO 82
1780    80 CONTINUE
1790 PRINT,"ERROR IN TABLE ID"
1800        GO TO 76
```

All weapon data are stored in arrays IW and XW. LTAB contains the starting indices for the tables. Local variables JS and JE are set to the beginning and ending indices belonging to the selected table (indexed by L).

```
1820    82 JS=LTAB(L)
1830       JE=JS+NTAB2(L)-1
```

The values of the weapon selection code, KODS, corresponding to the weapons in the selected table are set to 1.

```
1850       DO 84 L=JS,JE
1860    84 KODS(L)=1
```


The user is given the option of including only on-line weapons and only nuclear weapons.

```
1870 841 PRINT,"DO YOU WANT TO SEE ONLY ONLINE WEAPONS "
1880 READ 2,INS
1890 IF (INS,EQ,NO) GO TO 845
1900 DO 842 LL=JS,JE
1910 842 KODS(LL)=KODS(LL)*IW(6,LL)
1930 845 PRINT,"DO YOU WANT TO SEE ONLY NUCLEAR WEAPONS "
1940 READ 2,INS
1950 IF (INS,EQ,NO) GO TO 100
1960 DO 846 LL=JS,JE
1970 846 KODS(LL)=KODS(LL)*IW(7,LL)
1980       GO TO 100
```

The user has elected to select weapons by mission and is requested to enter the mission number. To allow the user to request help, the entry is read as an alpha character and must be converted to an integer.

```
1990C MISSION MODE SECTION
2000 86 PRINT,"ENTER MISSION NO,"
2010    88 READ 4,MIS
2030       IF(MIS .NE. H) GO TO 90
2040 89 PRINT," MISSIONS ARE :"
2041 PRINT," 1 = STRATEGIC INTERCON,"
2042 PRINT," 2 = STRATEGIC DEFENSE"
2043 PRINT," 3 = STRATEGIC PERPHERAL"
2044 PRINT," 4 = CONVENT, PERIPH,"
2045 PRINT," 5 = CONVENTIONAL FORCE PROJECTIONS"
2050       GO TO 86
2060C CONVERT MISSION NO, ENTERED (READ AS ALPHA) TO INTEGER
2070    90 DO 92 I=1,5
2080       IF(MIS .EQ. LIST(I)) GO TO 94
2090    92 CONTINUE
2100 PRINT,"ERROR IN MISSION NO,"
2110       GO TO 89
```

At this point the local variable, I, is set to the desired mission. If weapon K is assigned to this mission, the selection code, KODS(K), is set to 1.

```
2130    94 DO 96 K=1,NWP
2140       IF(IW(I,K) .EQ. 1) KODS(K)=1
2150    96 CONTINUE
2152 JS=1
2154 JE=NWP
2156 GO TO 841
```

Data values of some degree of uncertainty are marked in the data file. The user may display them. As a convention, user-entered values are not considered uncertain.

```
2160 100 PRINT,"THERE MAY REMAIN WEAPONS WITH ESTIMATED VALUES,"
2170 PRINT,"DO YOU WANT TO CHECK THEM "
2180 READ 2,INS
2190 IF (INS,EQ,NO) GO TO 101
2200 PRINT 961,"WEAPON ID  ",NATT
2210 961 FORMAT(1X,A11,7(4X,A4))
2220 KODPP=0
2230 DO 966 I=1,NWP
2235 IF (KODS(I),EQ,0) GO TO 966
2240 KODP=0
2250 DO 962 JJ=1,7
2260 IF (XWAST(JJ,I),NE,IASQ) GO TO 962
2270 KODP=1
2280 KODPP=1
2290 962 CONTINUE
2300 IF (KODP) 966,966,964
2310 964 PRINT 965,WPNID(I),(XW(JJJ,I),XWAST(JJJ,I),JJJ=1,7)
2320 965 FORMAT(1X,A11,1X,7(1X,F6,2,A1))
2330 966 CONTINUE
2340 KODX=1
2350 IF (KODPP) 967,967,968
2360 967 PRINT,"   NONE   "
```

After considering these uncertain values, the user may elect to return program control to the change section. Otherwise, control shifts to the final point at which the weapon selection code, KODX, is checked. If weapon selection has been made, the computation section is entered.

```
2370 968 PRINT,"DO YOU WANT TO MAKE ADDITIONAL CHANGES "
2380 READ 2,INS
2390 IF (INS,EQ,NO) GO TO 101
2400 GO TO 18
```

Computation section. The width of teletype paper makes it necessary to print the output tables in two sections, each covering 5 years. Rather than compute and store the effectiveness values, the computation section is repeated twice. Indices must be set to select the correct years for each section.

```
2410 101 DO 969 KP=1,2
2414 JE=5*KP
2416 JS=JE-4
2420 DO 103 L=JS,JE
2430 103 TOT(L)=0,
2432 PRINT 2435,(IYEAR(JJ),JJ=JS,JE)
2435 2435 FORMAT(" WEAPON ",5(8X,I4))
```

Each weapon is considered in turn. If weapons have been added, the ending index, KEND, must be reset to include them.

```
2440 KEND=NWP
2442 IF (MA,GT,NWP) KEND=MA
```

Since SMAX and VMAX will be used in the denominator, zero values are not allowed.

```
2460 IF (SMAX.EQ.0.) SMAX=1.
2470 IF (VMAX.EQ.0.) VMAX=1.
```

The computation of effectiveness is carried out for each weapon in which the selection code, KODS, has been set to 1.

```
2480       DO 110 I=1,KEND
2490 IF (KODS(I)) 110,110,104
2500  104 Y=XW(2,I)
2505 IF (Y.GT.1.) GO TO 105
2506 A=Y
2507 GO TO 107
2510 105 A=(Y-.1)**.3333
2520 107 F=XW(3,I)
2530 C=1./(XW(4,I)+1.)
2540       R=XW(5,I)
2550       S=1.+XW(6,I)/SMAX
2560       V=XW(7,I)/VMAX
2570       ZZ=Y*A*F*C*R*S*V*XW(1,I)
```

The local variable, ZZ, is set to the computed effectiveness of a single weapon. It must be multiplied by the number of weapons for each year.

```
2590 DO 106 L=JS,JE
2600       LL=LS+L-1
2610       N=IW(LL,I)
2620 IF (KODN(I).EQ.1) N=N/L6
2630 WEF(L)=N*ZZ*10.
2640 TOT(L)=TOT(L)+WEF(L)
2650 106 CONTINUE
```

```
2660C PRINT RESULTS FOR THIS WEAPON
2670 PRINT 29,WPNID(I),(WEF(JJ),JJ=JS,JF)
2680 29 FORMAT(1H ,A11,5F12.4)
2690  110 CONTINUE
```

The totals for each year are printed.

```
2691 PRINT 29,ITOT,(TOT(JJ),JJ=JS,JF)
2692 PRINT,"  "
2701 299 FORMAT(1H ,A11,10F6.0)
2702 969 CONTINUE
```


The user is given an opportunity to make an additional run. Otherwise, program execution is terminated.

```
2710 PRINT,"ANOTHER RUN NOW "
2720       READ 2,INS
2730       IF(INS .EQ. NO) GO TO 9999
```

Since the user has decided to make another run, the weapon selection code, KODX, must be reset to 0.

```
2740 KODX=0
```

If the user has made changes in weapon data, they may be retained for the next run. (It should be noted that in no case will these changes become part of the permanent data file.)

```
2742 IF (MA.GT.NWP) GO TO 112
2744 IF (MC.GT.0) GO TO 112
2746 DO 109 I=1,NWP
2748 IF (KODN(I).EQ.1) GO TO 112
2750 109 CONTINUE
2752 GO TO 10
```

If the user does not wish to use the changes in the next run, the old values must be reset.

```
2760 112 PRINT,"SAVE CHANGES FOR NEXT RUN "
2770 READ 2,INS
2780 IF (INS.NE.NO) GO TO 10
2782 IF (MC.EQ.0) GO TO 115
2790 DO 114 K=1,MC
2800 I=IWO(K)
2810 J=JWO(K)
2820 XW(J,I)=XWO(K)
2830  114 CONTINUE
2832 115 MA=NWP
2840       DO 116 K=1,NWP
2850 DO 116 L=9,38
2860       IF(IW(L,K) .LT. L6) GO TO 116
2870       M=IW(L,K)
2880       I=M/L6
2890       IW(L,K)=M-I*L6
2900  116 CONTINUE
```

```
2910 MC=0
2920 GO TO 10
```

Program execution is terminated.

```
2930 9999 STOP
2940 END
```

SUBROUTINE IPUT

```
2950 SUBROUTINE IPUT(MAXW,NAT,NTB,CACIFILE,NWP,STARTYR)
```

PURPOSE:

- To read the input data files and to store weapon data in arrays WPNID, IN, and XN.
- To determine the maximum values of weapon system velocity (SMAX) and vulnerability index (VMAX).

DECLARATION STATEMENTS

```
2960 COMMON DUMMY(36),IFLAG,ISRT,IPMAX,INDMAX,DATFILE,RPTFILE,FACFILE,
2970 &INDFILE,UPREFIX
2980 COMMON/ONE/WPNID(257),IW(38,257),XW(7,257),XWAST(7,257),NTAB2(12),
2990 &LTAB(12),SMAX,VMAX
3000 INTEGER ERRC<(225),SUM,STARTYR,YRVAL(30)
3010 CHARACTER RECORD*216,INDCHAR*83,RECID*11,TLIST*5(36),DOC*8
3012 CHARACTER *5 TABID
3020 CHARACTER *11 WPNID,RECID,ITOT
3030 CHARACTER *1 XWAST,UPREFIX
3040 INTEGER STARTYR,YRVAL
3060 CHARACTER *14 CACIFILE,DATFILE,INDFILE,RPTFILE,FACFILE
3061 DATA TLIST/"1A04 ","1A05 ","1A06","1B03 ","1B04 ","1B05 ","1C05 "
3062&,"1C06 ","1C07 ","2-01 ","2-02 ","2-03 ","3B01A","3B01B","3B01C"
3063&,"3C01A","3C01B","3C01C","4A07A","4A07B","4A07C","4B01A","4B01B"
3064&,"4B01C","4B06A","4B06B","4B06C","4B10A","4B10B","4B10C","4B19A"
3065&,"4B19B","4B19C","4C01A","4C01B","4C01C"/
```

The DIPP files are attached and various required indices read.

```
3070C         DIPP INDEX FILE ON LOGICAL UNIT 25
3075 SMAX=0,
3076 VMAX=0,
3080       CALL SUBATT(25,INDFILE,1,1,ISTAT)
3090       IF(ISTAT .NE. 0) GO TO 9999
3100C GIVE RANDOM FILE I/O ROUTINE NEEDED INFO
3110       CALL RANSIZE(25,22,1)
3120C GET # OF RECORDS IN INDEX FILE; NEEDED FOR SEEK SUBROUTINE
3130       READ(25'1,ERR=8888) INDCHAR
3140       DECODE(INDCHAR,995) INDMAX
3150  995 FORMAT(I5,83X)
3160C SUBATT DIPP DATA FILE ON LOGICAL UNIT 10
3170       CALL SUBATT(10,DATFILE,IPRMISP,1,ISTAT)
3180       IF(ISTAT .NE. 0) GO TO 9999
3190C GIVE RANDOM FILE I/O ROUTINE NEEDED INFO
3200       CALL RANSIZE(10,54,1)
3210C GET # OF RECORDS IN DATA FILE; NEEDED FOR SEEK SUBROUTINE
3220 READ(10'1,ERR=8888) RECORD
3230       DECODE(RECORD,350) IPMAX
3240  350 FORMAT(I5,211X)
```

Weapon data are read from the CACI file.

```
3260C READ IN CACI ATTRIBUTE FILE ON LOGICAL UNIT 8
3270 CALL SUBATT(8,CACIFILE,1,0,ISTAT)
3280       IF(ISTAT .NE. 0) GO TO 9999
3290       DO 10 I=1,NWP
3300       READ(8,900,END=90,ERR=91) RECID,(XW(J,I),XWAST(J,I),J=1,7),
3310&(IW(J,I),J=1,7)
```

```
3320 WPNID(I)=RECID
3330       TEST=XW(I,6)
3340 IF (TEST.GT.SMAX) SMAX=TEST
3350       TEST=XW(I,7)
3360       IF(TEST .GT. VMAX) VMAX=TEST
3370    10 CONTINUE
3380 900 FORMAT(A11,F5.0,A1,F9.2,A1,2(2X,F5.0,A1),2X,F5.2,A1,2X,F5.0
33818,A1,2X,F5.1,A1,2X,/I1)
```

Numbers of weapons are read from the DIPP files.

```
3430C MAIN LOOP TO EXTRACT DATA FROM DIPP: 1 PASS THROUGH LOOP FOR EACH OF
3440C THE 36 TABLES TO BE ACCESSED
3450 DO 20 I=1,36
3460 TABID=TLIST(I)
3490       ITR=(I-1)/3
3500       ISTART=LTAB(ITR+1)
3510       ISTOP=ISTART+NTAB2(ITR+1)-1
3520       I012=MOD(I-1,3)
3530       LS=9+10*I012
3540       LE=LS+9
3550C CALL SEEK TO FIND FIRST, LAST RECS FOR THIS TABID
3560       CALL SEEK(TABID,2,ISRTDAT,IENDDAT,DOC,$2001)
3570       DO 19 J=ISRTDAT,IENDDAT
3580       READ(10'J,ERR=8888) RECORD
3590       DECODE (RECORD,351) RECID,YRVAL
3600  351 FORMAT(13X,A11,56X,15(I2,I5),31X)
3610       DO 14 K=ISTART,ISTOP
3620       IF(RECID .EQ. WPNID(K)) GO TO 15
3630    14 CONTINUE
3640       GO TO 19
```

```
3650    15 DO 16 L=1,6
3655 IYZZ=YRVAL(1+2*(L-1))
3660 IF (IYZZ.EQ.STARTYR) GO TO 17
3670    16 CONTINUE
3680 PRINT,"START YEAR NOT FOUND,  NOS, SET TO 1"
3690 DO 22 M=1,10
3700 22 IW(LS+M-1,K)=1
3710 PRINT 351,RECID
3720    17 DO 18 M=1,10
3730    18 IW(LS+M-1,K)=YRVAL(2+2*(L+M-2))
3750    19 CONTINUE
3760    20 CONTINUE
```

Messages for various error conditions.

```
3870 50 CALL DETACH (8,ISTAT,)
3880 CALL DETACH(10,ISTAT,)
3890 CALL DETACH(25,ISTAT,)
3900 RETURN
3910 90 PRINT,"UNEXPECTED END-OF-FILE ENCOUNTERED WHILE READING"
3920 PRINT,"CACI ATTRIBUTE FILE, PROGRAM TERMINATING."
3930 STOP
3940 91 PRINT,"I/O ERROR OCCURRED WHILE ATTEMPTING TO"
3950 PRINT,"READ CACI ATTRIBUTE FILE, PROGRAM TERMINATING,"
3960 STOP
3970 2001 PRINT 2002,TABID
3972 2002 FORMAT(" ERROR RETURN FROM SEEK, TABID = ",A5)
3980 GO TO 20
3990 8888 PRINT,"RANDOM FILE I/O ERROR HAS OCCURRED IN SUBROUTINE IPUT"
4000 RETURN
4010 9999 PRINT,"EFFORT TO SUBATT A NEDED FILE WITH A CALL TO"
4020 PRINT,"SUBROUTINE SUBATT HAS FAILED, PROGRAM IS TERMINATING,"
4030 RETURN
4040 END
```

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